Economy and Environment Program
for Southeast Asia
22 Cross Street #02-55
South Bridge Court
Singapore 048421

Phone : (65) 6438 7877
Fax : (65) 6438 4844
E-mail : hfrancisco@idrc.org.sg
Web site : www.eepsea.org

The Economy and Environment Program for Southeast Asia (EEPSEA) was established in May 1993 to support training and research in environmental and resource economics across its 9 member countries: Cambodia, China, Indonesia, Laos, Malaysia, Papua New Guinea, the Philippines, Thailand, and Viet Nam. Its goal is to strengthen local capacity for the economic analysis of environmental problems so that researchers can provide sound advice to pollcymakers.

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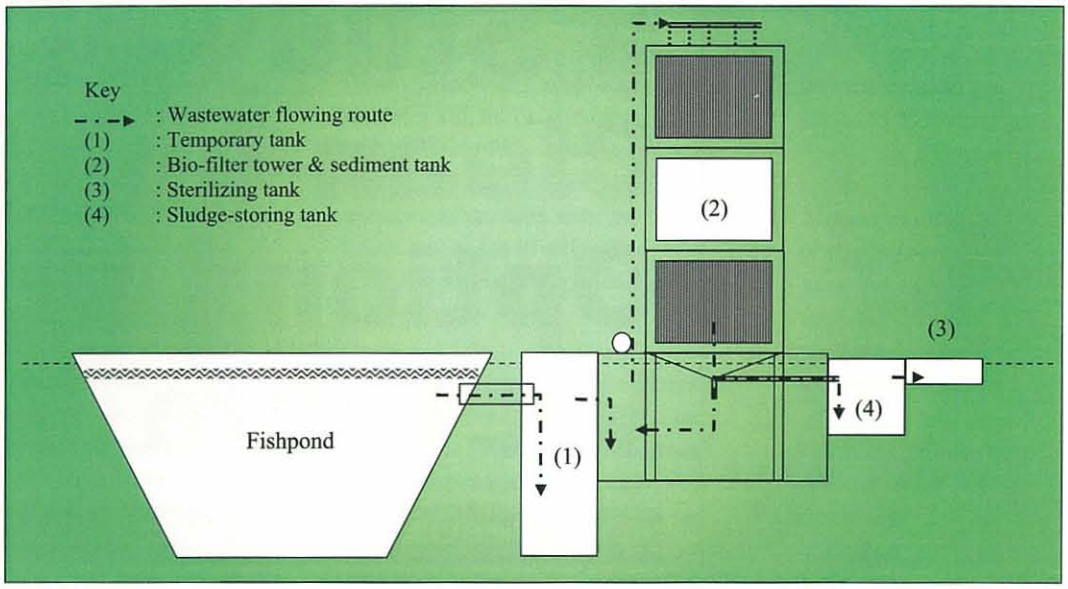
Fish Farm Pollution – a Study of Clean-up Options in Vietnam

EEPSEA POLICY BRIEF • No. 2009-PB3

Aquaculture is a thriving industry in the Mekong Delta (MD) of Vietnam. Tra fish are the most popular catfish species bred in the region and they have become an important export item. As such they are an economically valuable product for many MD farmers. However, catfish farming is causing problems for the environment. Waste, especially wastewater, from fish farms is →

A summary of EEPSEA Research Report No.2009-RR3: 'Environmental Consequences of and Pollution Control Options for Pond "Tra" Fish Production in Thotnot District, Cantho City, Vietnam, Vo Thi Lang, Ky Quang Vinh, and Ngo Thi Thanh Truc, School of Economics & Business Administration, Cantho University, 211, 30/4 Street, Ninh Kieu District, Cantho City, Vietnam.
Tel: (+84-710) 3 838831-839089 Fax: (+84-710) 3 839168
Email: vtlang@ctu.edu.vn

"a trickling-filter system would...



Trickling filter system

often not treated properly and is dumped into canals, creeks or rivers. This has a negative impact on local communities that rely on river water as their main water source. It also jeopardises the health of fish and the sustainability of the industry itself.

A new EEPSEA study looks at this problem and assesses a number of treatment options that could bring pollution down to acceptable levels. The study is the work of a research team led by Ms Vo Thi Lang, from Cantho University in Vietnam. It finds that a trickling-filter system would be the most cost-effective response to this challenge. However such a system would cost farmers more than they currently pay to discharge their polluting wastewater. The study therefore suggests a number of policy options that would encourage fish farmers to reduce the amount of pollution they discharge and help them to meet the necessary clean up costs.

The Mekong Delta's Fish Pollution Challenge

The fish farming industry in the MD has grown rapidly in the last two decades and production reached 625,397 tonnes of fish in 2003. Pollution from fish farms is acknowledged as a significant problem in the region and some fish farmers do try and treat the wastewater from their ponds. Current methods of pollution management involve the use of additional ponds to hold wastewater before it is released it into public water bodies. Unfortunately these ponds are often small and the water retention time too short, so this measure is not very effective.

If effective solutions to this problem are not put in place, the areas breeding Tra fish will soon not have enough clean water to meet local people's needs. The productivity of the Tra fish-farming industry will also be severely compromised by pollution. Vo Thi Lang's research team therefore set out to see how farmers could best clean up their fish farms and to highlight policy options that could address this pollution challenge.

Tra fish production is found in many provinces in the MD, but Thotnot District of Cantho City is the most famous breeding area and has the biggest area devoted to Tra fish farming. Thotnot was therefore chosen as the study site. Thotnot District lies along the Hau River. It has one town and seven communes. Its natural land area is 17,110.08 ha, with a population of 192,327 inhabitants and a population density of 1,124 persons/km2. Aquaculture areas have been growing in recent years, increasing from 209 ha in 2000 to 484.4 ha in 2005.

Talking to Fishermen

To get general information on the opinions and perceptions of local communities about Tra fish farming and its environmental consequences, focus group

be the most cost-effective response."

discussions were held in Thoi Thuan Commune. More detailed information on fish production costs, wastewater treatment and breeding practices was collected using a structured questionnaire. Secondary data relating to Tra fish production and its environmental consequences was collected from the Cantho Service of Agriculture and Rural Development, Cantho University, and local management agencies.

To assess the water pollution level caused by Tra fish farming, samples of Tra pond wastewater and river water were collected and analyzed. Five fish farmers sampled inlet and outlet pond water through the entire fish rearing cycle. A total of 178 water samples were collected. The organic pollution level in fishponds was measured by the COD parameter. COD is a chemical measure of the amount of organic substances in water or wastewater.

A 'costs and returns' analysis was used to assess the profitability of Tra fish production in Thotnot District. This assessment calculated the profits that fish farmers earned over a production cycle. This analysis was carried out to determine the financial robustness of the fish farmers and to see if they could afford to clean up their fishponds.

Which Clean-up Option is the Best?

The study assessed the effectiveness and viability of three possible technical options to reduce water pollution from Tra fish farming: an aeration system, a trickling filter system and a constructed wetland system. The first system involves the use of aeration and sterilizing tanks to treat wastewater. In the trickling filter system, wastewater from the fishponds is pumped to the top of a bio-filter tower in which it is cleaned. In the wetland system, wastewater is filtered through a tank containing a living wetland system.

To identify the most cost-effective technological option, the abatement costs of each of these options were estimated and compared. Two measurements of costs were used; the abatement cost per kilogram of COD and the COD abatement cost per kilogram of fish growth. To assess the social acceptability of the three options, two focus group discussions were organized. The first provided general judgments and the second asked local people to rank the options in terms of their preferences.

The study finds that the dumping of Tra fish waste into public water channels by fish farmers has two main impacts: It has jeopardized the health of the fish being reared; it has also contaminated the domestic water supply used by local people. The Ministry of Fisheries has laid down specific guidelines for pond construction and requirements for pond sediment and wastewater storage. However, in reality, fish farmers do not abide by these rules and still discharge untreated wastewater into local waters. Water sample analysis shows that the COD concentration in Tra pond wastewater is 34 mg/l. This exceeds the limit of <10 mg/l that is set out in Vietnam's surface water quality standards.

Clean-up will be Costly

Among the clean-up options assessed, the trickling filter system was found to be the most cost-effective. The treatment cost per kilogram of COD for this system was VND 0.83 thousand (≈ USD0.05). This compared to VND 1.51 thousand (≈USD 0.09) for the aeration system and VND 2.27 thousand (≈USD 0.14) for the constructed wetlands system. The treatment costs per kilogram of fish produced were VND 0.148 thousand for the aeration system, VND 0.081 thousand for trickling

Results of preference ranking of options

Most preferred option	Number	Percentage
1. Aeration system	5	36
2. Trickling filter system	7	50
3. Constructed wetland system	0	0
4. No ranking	2	14
Total	14	100

Source: synthesized from individual fish farmers' matrices

filters, and VND 0.223 thousand for constructed wetlands. These costs are equivalent to 7.5%, 4%, and 11% of fish production profits, respectively.

It should be noted that all of these costs would put a significant financial burden on fish farmers. They are all much greater than the environmental protection fee that is currently imposed by the government on industrial as well as domestic wastewater. This currently stands at VND 0.3 thousand/kg of COD. In addition, all three options need extra land (about 18-26% of pond water surface area), adequate power supplies and considerable investment. These all represent significant economic challenges to fish producers.

When local people were asked which clean-up system they would prefer, 50% chose trickling filters, 36% chose aeration systems, no one chose constructed wetlands, and 14% refused to rank. All of the respondents suggested that the State should install these systems as pilot projects to demonstrate their effectiveness. It was also suggested that a collective organization should be set up to manage wastewater treatment in the area.

Helping Farmers to Clean up their Ponds

The study highlights the following conclusions: It is clear that the COD treatment costs of all the proposed clean-up technologies are rather high. In particular the COD treatment costs estimated in this study are greater than the wastewater discharge fees farmers have to pay. This situation does not encourage individual farmers to invest in technical clean-up options, as there will be no economic gain involved. Therefore, state agencies should compare current environmental fees with the COD treatment costs of different technologies and adjust the fees accordingly.

Due to the high initial investment costs of the treatment technologies, farmers are unwilling to implement them without support. Local governments should therefore set up an environmental fund to provide long-term loans (with preferential interest rates) to enable fish farmers to build treatment systems. In addition, policymakers should think of establishing state-financed pilot waste treatment systems to demonstrate the usefulness of these systems to farmers. To make fish producers accept treatment costs more willingly, local governments should also take into account fish farmers' wastewater treatment costs (per kilogram of fish produced) before setting a buying price for Tra fish bought from farmers.

The study recommends a number of other policy ideas that would help to reduce water pollution caused by Tra fish production. Firstly, the proposed Tra fish planned zones in Cantho City should be put in place. These zones have been planned but not yet established. They would pave the way for concentrated wastewater treatment systems, which will help reduce COD treatment costs. Secondly, it is essential to set effective emission standards for Tra fishpond wastewater released into public water bodies. This would spur the application of efficient technologies to reduce organic matter concentration in the wastewater.

Looking to the future, the study recommends that agricultural agencies study and formulate clean Tra fish culture processes in accordance with national food safety and hygiene standards. Once these have been worked out, they should be implemented and strictly enforced. However, at present, while there are no effective measures to curb water pollution yet in place, the study highlights the need for relevant government agencies to make sure that local people have alternative clean water supplies so that they do not have to rely on water contaminated by fish farming.

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